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Park characteristics, use, and physical activity: A review of studies using SOPARC (System for Observing Play and Recreation in Communities)

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Abstract

The System for Observing Play and Recreation in Communities (SOPARC) can obtain information on park users and their physical activity using momentary time sampling. We conducted a literature review of studies using the SOPARC tool to describe the observational methods of each study, and to extract public park use overall and by demographics and physical activity levels. We searched PubMed, Embase, and SPORTDiscus for full-length observational studies published in English in peer-reviewed journals through 2014. Twenty-four studies from 34 articles were included. The number of parks observed per study ranged from 3 to 50. Most studies observed parks during one season. The number of days parks were observed ranged from 1 to 16, with 16 studies observing 5 or more days. All studies included at least one weekday and all but two included at least one weekend day. Parks were observed from 1 to 14 times/day, with most studies observing at least 4 times/day. All studies included both morning and afternoon observations, with one exception. There was a wide range of park users (mean 1.0 to 152.6 people/park/observation period), with typically more males than females visiting parks and older adults less than other age groups. Park user physical activity levels varied greatly across studies, with youths generally more active than adults and younger children more active than adolescents. SOPARC was adapted to numerous settings and these review results can be used to improve future studies using the tool, demonstrate ways to compare park data, and inform park promotions and programming.

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None.

Keywords

Observation; Park and recreation; Physical activity; Sedentary behavior; Surveillance

1. Introduction

Public parks are widely available free or low cost resources for physical activity, with more than 9000 local park and recreation departments and organizations managing more than 108,000 public park facilities and 65,000 indoor facilities in the United States (US) (Godbey and Mowen, 2010). Identifying the demographics and physical activity levels of park users could inform park promotions and programming and be used to develop interventions to promote physical activity and reduce sedentary behavior through park use. The System for Observing Play and Recreation in Communities (SOPARC) tool was designed to obtain information on area users and their physical activity while in community environments and uses momentary time sampling to record observations (McKenzie et al., 2006; Active Living Research, 2016). When applied to park settings, a park is mapped and target areas are created to subdivide the park space for observation. Various characteristics about the target areas can be collected and observational scans of target areas are performed periodically to obtain information such as the number of parks users and their gender, age, race/ethnicity, and physical activity. A scan is a single observation or visual sweep from left to right across the target area.

Systematic observation can be used to assess the environmental contexts in which physical activity occurs, and in recent years many studies have used SOPARC to observe park use (McKenzie and van der Mars, 2015). Reviewing the SOPARC study methods can highlight ways to modify or improve the tool and may permit comparisons of data across parks, park systems, and studies. Additionally, reviewing SOPARC study results provides a way to summarize park usage (by demographics and physical activity level) across diverse geographic areas while ensuring quality and comparability in the underlying data collection. Thus, we conducted a literature review using the SOPARC tool through 2014 to describe the observational methods of each study, and to extract municipal or county level public park use overall and by demographics (age, gender, race/ethnicity) and physical activity levels across a variety of geographic settings.

2. Methods

Searches of PubMed, Embase, and SPORTDiscus were conducted to include only full-length observational studies published in English in peer-reviewed journals through December 31, 2014. Each search used the term SOPARC, both abbreviated and spelled out, and “System for Observing Play and Leisure Activity in Youth” (SOPLAY) combined with “park”. In addition, we searched the reference lists of included studies for possible studies missed by the searches. The search results were described based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009; Moher et al., 2009).

We excluded abstracts, conference proceedings, studies evaluating park-related interventions (since park use may change as a result of the intervention), studies using tools only other than SOPARC (such as the Environmental Assessment of Public Recreation Spaces (EAPRS) (Bruton and Floyd, 2014; Perry et al., 2011) or Public Open Space (POS) (Giles-Corti et al., 2005)), studies with walking path observations only (Jia and Fu, 2014), and studies using SOPARC that did not specifically report on park use (Han et al., 2013, 2014). We excluded studies that extensively modified the tool for use in large park areas, such as at hotel waterparks (Ramos and Ross, 2013), state parks (Whiting et al., 2012), and national parks (Walden-Schreiner et al., 2014). We also excluded studies that used modifications of SOPARC to only capture activities outside of park use, such as joint use of schools (Lafleur et al., 2013) and youth sports (Cohen et al., 2014).

An abstraction tool was developed to extract the number of parks and target areas (subdivided areas of the park space), their location, park size, and observation frequency including number of days (weekend and weekday) and times per day. An observation period was defined as one full rotational assessment of a park, which included scanning, in sequence, all the target areas that comprised the park. Target area characteristics were also extracted, including whether the park was accessible (not locked or rented to others), dark, empty, and usable (physical activity can be performed here and the area was not excessively wet or windy), and whether or not there were activities that were organized (by personnel), equipped (with loose, non-permanent equipment), and supervised by park staff or other personnel. For park users, we extracted the number of people, demographics (age, gender, race/ethnicity), and physical activity level overall and by demographic characteristics, if reported. We focused on overall results, and if not available then we extracted results by season. According to the original SOPARC protocol (McKenzie et al., 2006), physical activity is collected as sedentary (lying down, sitting, or standing in place), walking (casual pace), or vigorous (greater than an ordinary walk). The original age categories identified in the SOPARC protocol were 0–12,13–20,21–59, and > = 60 years. We also abstracted reliability results from the included studies, specifically for number of people observed, age, gender, race/ ethnicity, physical activity, and target area characteristics defined in the original SOPARC protocol when reported. We did not abstract reliability results documented during training, but rather focused on reliability during data collection. Each included article was abstracted by a primary reviewer and checked by a second reviewer, with disagreements resolved by consensus. Summary tables were created from the abstracted information and grouped by study since some projects produced more than one paper.

In order to compare across studies with different observational methods, we calculated two summary measures.

$$\begin{aligned}&\text{total number of people observed in a park per day}\\&\quad=\text{total number of people observed}/(\text{total number of study perks}\\&\qquad*\text{number of observed days}*\text{number of seasons})\end{aligned} \tag{1}$$

$$\begin{aligned}&\text{total number of people observed in a park per observation period}\\&\quad=\text{total number of people observed in a park per day}/\\&\quad\text{number of observation periods}\end{aligned} \tag{2}$$

3. Results

3.1. Description of included studies

The search yielded 99 articles. Twelve additional articles came from other sources (i.e., reference lists of included articles). All were screened for inclusion (Appendix Fig. 1). In this review, we included 34 articles representing 24 distinct studies (Table 1). However, in one case we presented an earlier study that reported only on adults (Reed et al., 2008) as well as the extension of the study that reported only on youth (Reed and Hooker, 2012). The earliest study initiated observations in 2003 (McKenzie et al., 2006), when the SOPARC method was created, and the latest study started observations in 2013 (Roemmich and Johnson, 2014). While all studies employed SOPARC observational techniques, two studies referred to using SOPLAY (an earlier version of SOPARC) (Coughenour et al., 2014; Floyd et al., 2008a).

3.2. Protocol differences

The original SOPARC method was modified for use in several studies and is detailed for consideration when interpreting results across studies. One study separated standing from other sedentary behaviors during the scan (Roemmich and Johnson, 2014). One identified whether or not a person was accompanied by a dog (Temple et al., 2011) and another modified the tool to observe users up to 2 min in order to capture dog-related questions (i.e., number of dogs, dog size) (McCormack et al., 2014). One study described cultural adaptations of the tool for use in Taiwan (Pleson et al., 2014) and another study did not use target areas, but rather documented park user information and activities for the entire park at one time for 3 of 4 parks (McCormack et al., 2014). This last study also recorded information on one park user at a time by observing him or her for up to 2 min in order to record multiple activities. The authors reported that these protocol modifications worked for smaller parks and minimized the possible double counting of park users.

In terms of park users, one study reported observing adults only (Reed et al., 2008) and two reported observing youths only (Coughenour et al., 2014; Floyd et al., 2011; Reed and Hooker, 2012). Several other studies modified the age categories by combining teenagers with adults (< = 12 years and > = 13 years) (Chung-Do et al., 2011; Floyd et al., 2008a) and two studies combined all youths, not distinguishing younger and older youths (Child et al., 2014; McCormack et al., 2014). Unique to the one study (Kaczynski et al., 2011), researchers set a lower age limit at 2 years for observation.

3.3. Geographic setting

US was the location for 19 studies, with one of these comparing findings to parks in Belgium (Van Dyck et al., 2013). Other countries included Brazil (Hino et al., 2010),

Canada (McCormack et al., 2014; Temple et al., 2011), Taiwan (Pleson et al., 2014), and Turkey (Muftuler et al., 2011). Park types ranged from small town squares (Hino et al., 2010) to large district parks (Chung-Do et al., 2011).

3.4. Park selection

A wide range of criteria were used for selecting parks, including prior or current participation in a research or grant initiative (Banda et al., 2014; Reed et al., 2012), availability of programming activities (Hino et al., 2010; Shores and West, 2008a), having dog-related park policies (McCormack et al., 2014; Temple et al., 2011), or whether the park offered a variety of amenities (Kaczynski et al., 2011; Muftuler et al., 2011), had a recreation center (Cohen et al., 2012), had at least one full-time staff (Cohen et al., 2012), or was designated for improvements (McKenzie et al., 2006). Some studies allowed the city park and recreation staff to choose the parks (Reed et al., 2008, 2012), while one study chose parks based on popular use by adult users (Pleson et al., 2014). Two studies used random park selection (Floyd et al., 2011; Pleson et al., 2014). Studies also selected parks based on representation of neighborhood demographics (e.g., income or race/ethnicity) (Chung-Do et al., 2011; Cohen et al., 2013, 2011, 2012; Coughenour et al., 2014; Floyd et al., 2008a; Hino et al., 2010; McKenzie et al., 2006; Rung et al., 2011; Van Dyck et al., 2013), environmental characteristics (Hino et al., 2010), walkability (Van Dyck et al., 2013), park size (Chung-Do et al., 2011; Muftuler et al., 2011), park planning district (Rung et al., 2011), and park types (Shores and West, 2010).

3.5. Park observation methods and overall use

The number of parks observed per study ranged from 3 (Muftuler et al., 2011) to 50 (Cohen et al., 2012) (Table 2). Most studies observed parks once during one season, with other studies observing multiple times across two (Banda et al., 2014; Cohen et al., 2011; Reed et al., 2012; Temple et al., 2011), three (Cohen et al., 2013), or all four seasons (Roemmich and Johnson, 2014).

The number of days parks were observed ranged from 1 (Pleson et al., 2014) to 16 (Floyd et al., 2011), with 16 studies observing ≥5 days (Banda et al., 2014; Child et al., 2014; Chung-Do et al., 2011; Cohen et al., 2011, 2012, 2013; Floyd et al., 2011; Hino et al., 2010; McKenzie et al., 2006; Muftuler et al., 2011; Reed et al., 2008; Roemmich and Johnson, 2014; Reed and Hooker, 2012; Shores and West, 2008a, 2010). All studies included at least one weekday and all but two studies included ≥1 weekend day (exceptions were Rung et al. (2011) and Pleson et al. (2014) for 6/7 parks). The number of times per day parks were observed ranged from 1 to 14, with most studies observing at least 4 times/day (exceptions were Floyd et al., 2011; Hino et al., 2010; McCormack et al., 2014; Pleson et al., 2014; Roemmich and Johnson, 2014; Temple et al., 2011). All studies included both morning and afternoon observations, with one exception in which some parks were observed during the morning or evening only (Pleson et al., 2014).

For the studies with sufficient data to complete the calculation, the mean number of people per park per day ranged from 4.0 (May only) (Banda et al., 2014) to 737.9 (Kaczynski et al., 2011). When accounting for the number of observation periods per day, the range of users

per park per observation period ranged from 1.0 (May only) (Banda et al., 2014) to 152.6 (Cohen et al., 2012).

3.6. Target area characteristics

About half of the studies reported at least one target area characteristic (Table 3) and one study reported on characteristics for the entire park rather than for each target area (Pleson et al., 2014). The accessibility (range 82–100%, with the exception of two parks in Banda et al., 2014) and usability (85–100%) of the target areas were generally high. Fewer target areas had organized (range 0–31%), equipped (range 0–15%), or supervised (range 0–31%) activities. Two studies reported on whether the target area was dark, ranging from 0 to 9% (Cohen et al., 2013; McKenzie et al., 2006).

The percentage of target areas that were empty when scanned ranged from 53% to > 94%. One study found more empty target areas occurred in higher poverty parks (Cohen et al., 2012). One study reported that no one was observed in 2 of 25 parks (Reed et al., 2008), and another noted 2 of 39 parks had no park visitors and thus excluded them from the analysis (Rung et al., 2011).

3.7. Park observations by demographics

In studies that collected youth and adult user data separately, the majority (> 50%) of users were youths in five studies (Banda et al., 2014; Child et al., 2014; McKenzie et al., 2006; Reed et al., 2012; Roemmich and Johnson, 2014), and adults in five studies (Cohen et al., 2012; Kaczynski et al., 2011; Muftuler et al., 2011; Pleson et al., 2014; Shores and West, 2008) (Table 4). For the studies that distinguished adults from older adults, the proportion of older adults was small, ranging from 1% (Cohen et al., 2013) to 13% (females in town squares) (Hino et al., 2010),with the exception of one study which reported 61% of park users were older adults (Pleson et al., 2014).

In 20 studies more males than females were observed in parks, while two studies reported fewer males (49% (Muftuler et al., 2011); 44% (Pleson et al., 2014)) and one study reported no gender differences (Kaczynski et al., 2011) (Table 4). One study did not report park observations by gender (Temple et al., 2011). Several studies reported users by race/ethnicity, with the highest proportion of users being White (Cohen et al., 2013; Kaczynski et al., 2011; Reed et al., 2008, 2012; Reed and Hooker, 2012; Shores and West, 2008a; Van Dyck et al., 2013), African American (Banda et al., 2014), or Hispanic (McKenzie et al., 2006).

3.8. Park observations by physical activity

The distribution of observed physical activity levels varied greatly across parks (Table 5). Those observed as sedentary (i.e., lying down, sitting, or standing still) ranged from a mean of 14% (Pleson et al., 2014) to 70% (Florida only) (Floyd et al., 2008a). Eight studies reported that fewer than half of park users were sedentary (Coughenour et al., 2014; McCormack et al., 2014; Pleson et al., 2014; Reed et al., 2008, 2012; Reed and Hooker, 2012; Shores and West, 2008a; Temple et al., 2011), six studies reported 50% or more were being sedentary (Chung-Do et al., 2011; Cohen et al., 2012; Floyd et al., 2011, 2008a;

Kaczynski et al., 2011; McKenzie et al., 2006), and four studies described variability both above and below 50% (Banda et al., 2014; Child et al., 2014; Shores and West, 2010; Van Dyck et al., 2013). A similar wide range of findings was found for physical activity, with the proportion walking ranging from 5% (urban parks) (Shores and West, 2010) to 80–100% (assessed in 2008) (Temple et al., 2011), and the proportion engaging in vigorous activity ranging from 6% (Kaczynski et al., 2011) to 72% (urban parks) (Shores and West, 2010). One study recorded only walking (81%) and vigorous (19%) physical activity, and not sedentary behavior (Muftuler et al., 2011).

Studies that distinguished youth from adult park users reported youths to be generally more active (Kaczynski et al., 2011; Reed et al., 2012; Roemmich and Johnson, 2014; Shores and West, 2008a, 2010). Younger children were generally more active (walking plus vigorous) and less sedentary than older youths (Floyd et al., 2011; Reed and Hooker, 2012). On average, male park users were more likely to be observed being physically active than female park users, whether combined overall or when youths were distinguished from adults (Chung-Do et al., 2011; Cohen et al., 2012; Coughenour et al., 2014; Floyd et al., 2008a, 2011; Kaczynski et al., 2011; McKenzie et al., 2006; Reed et al., 2008; 2012; Reed and Hooker, 2012; Roemmich and Johnson, 2014; Rung et al., 2011; Shores and West, 2010). However, an exception occurred for children in Illinois parks, where no differences in physical activity by gender were observed (Floyd et al., 2008a).

Physical activity intensity by race/ethnicity among park users was inconsistent across the few studies that reported it. In selected Kansas parks, proportionally more Asians were observed in walking and vigorous activity, followed by Whites, Blacks, and Hispanics (Kaczynski et al., 2011).Two studies reported that White park users were more vigorously active but engaged in less walking compared to other race/ethnicities (Reed et al., 2008; 2012) and another study found no differences by race/ethnicity (Shores and West, 2008a).

3.9. Reliability

Among the studies included in the review, about half provided some evidence of inter-rater reliability during data collection. In addition to the studies reported in Table 6, the study by Kaczynski et al. (2011) and Besenyi et al. (2013) reported only a range of reliability for all recorded user characteristics (0.84–0.98 and 0.84–0.90, respectively). In general, average percent agreement and correlation coefficients exceeded 80% and 0.80, respectively, for total number of people observed, age, gender, race/ethnicity, and physical activity. When kappa coefficients were reported, they tended to be lower.

4. Discussion

This review included 34 articles from 24 observational studies applying the SOPARC tool to a wide range of park settings. Despite differing methods in applying SOPARC, we calculated park use across studies and found the average number of people per park per observation period ranged from a low of 1.0 in rural southern US parks (Banda et al., 2014) to a high of to a high of 152.6 for parks in Los Angeles, CA (Cohen et al., 2012). We found four consistent findings across studies, regardless of protocol modifications, park locations, or park types. First, males generally used parks more than females, regardless of age group.

Second, males were typically more physically active in parks than females. Third, youths were generally more active in the park than adults. Fourth, older adults were infrequently observed in the parks, with the exception of a study in Taiwan (Pleson et al., 2014).

Several findings from this review highlight areas for future work. Studies from the US dominated the samples; reports from other countries and cross-country comparisons of park use and non-use would be a valuable addition. However, the search included only English language articles and thus likely missed valuable non-English language contributions. Few studies included parks in rural areas, and a better understanding of park use patterns and preferences of rural residents is warranted. Although SOPARC provides a protocol for collecting data on target area characteristics, very few studies reported this information on all the characteristics. Future studies should incorporate these metrics to assess whether parks are meeting national goals such as accessibility and to aid understanding of which factors influence park use. As well, it should be made clear when only certain areas of a park are observed, so the target area characteristics can be interpreted appropriately.

Most studies selected parks based on specific characteristics rather than to represent a community park system as a whole, thus hampering generalizability. Parks were also usually studied during only one or two seasons of the year, and observations were scheduled during times of day when more park users would likely be present. Additionally, some studies scanned only certain areas of a park (probably where more activity would occur), rather than an entire park. If SOPARC is to be used for surveillance purposes, then further consideration should be given to the appropriate sampling of parks, timing of observations, and the amount of park coverage for target areas. For example, in large park systems, random sampling of parks to represent the system may work well. Stratified sampling may be needed to ensure adequate representation of certain types of parks or potential users of parks.

Future research can leverage recent technological advances to improve observer training and enhance data collection, transfer, and storage, all of which allow for improved data comparisons among studies. SOPARC training videos, for example, are available for free on-line through iTunes University (McKenzie, 2016). As well, the RAND Corporation created an on-line site which permits anyone with an Internet connection to enter SOPARC data and retrieve a summary at no cost (McKenzie et al., 2016). In addition, an app called iSOPARC includes functions for simultaneously collecting standard SOPARC variables with global positioning system and photographic data using iPads. It is available free from the Apple iTunes Store (Ciafel, 2016) and enhances the collection and management of data.

The strengths of the SOPARC tool include the absence of participant burden and the ability to provide information on people and park characteristics at a relatively low cost that enables comparisons across parks and geographic systems. With proper observer training, the SOPARC measurements are reliable as indicated in Table 6 and elsewhere (Bocarro et al., 2009). This review also highlighted the flexibility of the SOPARC tool enabling it to be modified from its original format. For example, to collect data on children only (Coughenour et al., 2014; Floyd et al., 2011; Reed and Hooker, 2012) or to focus on dog-related questions (McCormack et al., 2014; Temple et al., 2011). Others have suggested modifications to the tool to assess persons with disabilities who use a park (Aytur et al., 2015). Nonetheless, if

the tool is to be used for surveillance purposes or to make more direct comparisons across studies, then use of a single protocol is needed.

In terms of the frequency of observations, a study that observed suburban and urban parks hourly for 14 h/day, over an entire week in multiple seasons and locations, found that estimates of park use by gender, age, race/ethnicity, and physical activity could be made reliably using an abbreviated schedule of 4 days/week and observing 4 times/day (Cohen et al., 2011). We found that most studies used an observation schedule in line with this recommendation.

According to the original SOPARC protocol, a count of the number of park users in each age, race/ethnic, and physical activity category is completed during each scan, separately for males and females (McKenzie et al., 2006). Scanning in this way meant that physical activity could be stratified by gender, but not by age or race/ethnic group, although some subsequent studies modified the protocol to address this. Even so, fewer than half of the studies reported on race/ethnicity of park users. Researchers should consider what data are most relevant to the study goals to determine the best design for scanning target areas. Another consideration is the way sedentary behavior is defined. The original protocol defined sedentary behavior to include lying down, sitting, and standing without moving. Researchers may wish to distinguish between these behaviors in future iterations.

Several features and limitations of the SOPARC tool deserve highlighting. Due to the frequency and nature of scanning target areas, characteristics such as age, race/ethnicity, and physical activity must be grouped into only a few categories, particularly to maintain reliability and to not overwhelm observers in densely occupied locations. The assessments occur at a moment in time and not continuously over the course of an individual’s park visit (Spengler et al., 2011). For example, a person who was active at the park, but sat down to take a break during the scan would be coded as sedetnary, even though the person might have been active during most of their park visit. However, conducting sufficient observation samples at regular predetermined intervals should overcome this issue and represent park use. The SOPARC methods, as with other direct observation protocols, do have the potential for those being observed to react to the presence of data collectors. To counter this reactivity, one study recommended that observers be located to guarantee the lowest visibility by park users (Parra et al., 2010). Finally, when evaluating changes in park use over time, the SOPARC tool cannot discern new park users from repeat users or neighborhood residents from non-residents (Veitch et al., 2012). Combining direct observation with other data collection techniques, such as other types of audits, interviews, and self-reports, are needed to discern subtleties such as these, and the triangulation of data is useful in best describing park use, preferences, attitudes, and policies.

4.1. Review limitations

While our review was comprehensive, several limitations should be acknowledged. The SOPARC tool has a standardized protocol, and all included studies referred to this tool (McKenzie et al., 2006). However, many studies deviated from this protocol for a variety of reasons, including differing study goals, expense, and feasibility. These deviations made comparisons across studies more challenging. Although we highlighted major protocol

changes, future comparisons of study findings could consider the impact of these modifications. In addition, temporal differences with respect to season and year were not accounted for in our comparisons but were noted in Table 1. Moreover, the park metrics we derived could not account for park size, since many studies did not report it and often focused only on developed park areas. Future studies should report park size and the park use metrics we calculated could be used in meta-analyses across studies to assess correlates of park use. However, with the current state of the literature, particularly the varying park selection methods, such detailed, quantitative comparisons are not easily captured.

5. Conclusions

The results of this review can be used to improve the SOPARC tool and to promote its standardization for use in surveillance efforts. The tool could be used to further understand underutilized parks and park areas, and to evaluate interventions designed to change park usage. Based on the findings from this review, SOPARC can also be used to in-form park promotions, assist designers in developing relevant park features, inform long-range park planning, and target park programming to attract diverse users that represent the community at large across the park system. The tool can also be used to evaluate comprehensive interventions designed to increase park use (e.g., environmental, policy, programming, promotions), ultimately to increase physical activity and decrease sedentary behavior through park use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Summary of park observation data collection across included studies; SOPARC review (2006–2014).

First author, publication year	Location	Size of parks	Season/month and year	Number of target areas	Modified observations
Banda et al. (2014)	County in central SC; US		May 2010 October 2010	42 total; mean 7 per park 42 total; mean 7 per park	
Child et al. (2014)	San Ysidro, CA and National City CA; US	(Range 25–50 acres)	April 2007–May 2007	147 total; mean 18 per park (range 8–28)	Used 3 age categories: 0–17, 18–59, > = 60 years
Chung-Do et al. (2011)	Honolulu, HA; US		June 2009–October 2009	130 total; mean 22 per park	Did not collect race/ethnicity
Cohen et al. (2011)	Los Angeles, CA; Albuquerque, NM; Durham, NC; Columbus, OH; Philadelphia, PA; US	Mean 15.4 acres (range 4.7–39.5 acres)	Summer and fall 2008 for NM, NC, OH, and PA parks; spring and fall 2008 for CA parks	274 total; mean 31 per park (range 19–53)	
Cohen et al. (2012)	Los Angeles, CA; US	Mean 8.7 acres high poverty, 15.9 acres medium poverty, 15.4 acres low poverty	April 2008–March 2010	1705 total at time 1, mean 34 per park (range 12–78); 1814 at time 2, mean 36 per park (range 12–90)	
Cohen et al. (2013) Ward et al. (2014)	Albuquerque, NM; Durham, NC; Columbus, OH; Philadelphia, PA; US	Mean acres: 13.5 NC, 7.3 NM, 6.9 OH, 6.8 PA (range 3.6 to 24.0 acres)	Spring, summer and fall (varied by year) 2010–2011	719 total; mean 30 per park	
Coughenour, et al. (2014)	Las Vegas, NV; US	Mean 19.0 acres (range 1.7–72.2 acres)	June 2012–July 2012	~60	Youth only
Floyd et al. (2008a,b), Spengler et al. (2011), Suau et al. (2012)	Tampa, FL and Chicago, IL; US	FL mean 41 acres (range 11.4–145 acres); IL mean 46 acres (range 8–207 acres)	March 2005–April 2005 FL parks; May 2005–June 2005 IL parks	FL 122 total, mean 12 per park; IL 178 total, mean 10 per park	
Floyd et al. (2011) *, Baran (2013)	Durham, NC; US	Mean 10.3 acres (range 0.5–45.9 acres)	May 2007–July 2007	134 total; mean 8 per park (range 1–14)	Youth only; observed whether youths were accompanied by an adult
Hino et al. (2010)	Curitiba, Brazil	Mean size of target areas: 1183.4 m^2 in parks and 310.1 m^2 in squares	March 2008–April 2008	110 total; 34 in parks and 66 in squares, total	
Kaczynski et al. (2011), Besenyi et al. (2013)	Kansas City, MO; US	Mean 66.8 acres	July 2009–August 2009	83 total; mean 21 per park (range 14–28)	
McCormack et al. (2014)	Calgary, Canada	Mean 6.6 ha (range 1.1–21.6 ha)	May 2011–July 2011	5 total; mean 1.3 per park; 1 for 3 parks and 2 for 1 park	Observed users up to 2 min to maximize number of users observed

First author, publication year	Location	Size of parks	Season/month and year	Number of target areas	Modified observations
McKenzie et al. (2006), Cohen et al. (2007)	Los Angeles, CA; US	Mean 7.8 acres (range 3.4–16.0 acres)	December 2003–May 2004	165 total; mean 21 per park (range 17–27)	
Muftuler et al. (2011)	Ankara, Turkey	Mean 41,714 m^2 (range 4141–110,000 m^2)	August 2009	14 total; mean 4.7 per park (range 4–6)	
Pleson et al. (2014) Reed et al. (2008)	Taipei, Taiwan Southeastern county; US	Ranged from one basketball court to over 126 acres	April 2011 Summer 2004 and summer 2005	35 total; mean 5.0	did not collect race/ethnicity Adults only; did not observe entire park but focused on 9 activity settings
Reed et al. (2012)	Detroit district 10, counties: Delta, Menominee, Ingham, Kalamazoo, Maquette, Ottawa, Washtenaw, Muskegan, Wayne, Chippewa; MI; US		Spring 2008–summer 2010		
Reed and Hooker (2012)	Southeastern county; US		Summer 2004–summer 2008		Youth only; did not observe entire park but focused on 8 activity settings
Roemmich and Johnson, (2014)	Grand Forks, ND; US		Summer/fall 2012 and winter/spring 2013		Included “standing” physical activity category separate from “sedentary”
Rung et al. (2011), Broyles et al. (2011)	New Orleans, LA; US	Mean 2.9 acres (range 0.2–8.6 acres)	June 2008–August 2008	154 total; mean 4 per park	
Shores and West, 2008a,b	Community in eastern US	Mean 8.2 acres (range 1.6–14.5 acres)	Summer 2006		
Shores and West, (2010)	A rural and urban area in NC; US	Mean 12.1 acres (range 3–23 acres)	Summer 2008		
Temple et al. (2011)	Victoria, British Columbia, Canada	(Range 0.6–13.5 ha)	Season 1: 6 weeks in May, June, and September 2007; season 2: 6 weeks in January 2008–April 2008	1 or 2 per park	Data recorded during 6 sweeps of 10 min for users with and without dogs
Van Dyck et al. (2013)	Ghent, Belgium and San Diego, CA; US	Mean 7.6 ha	Ghent: August 2011 – September 2011; San Diego: October 2011–November 2011		

A * indicates the article used for the numbers provided in the table. Empty cells indicate information not reported in the articles. Data is reported by season only when not presented overall in the paper.

Abbreviations: CA, California; FL, Florida; HA, Hawaii; IL, Illinois; LA, Louisiana; MI, Michigan; MO, Missouri; NC, North Carolina; ND, North Dakota; NM, New Mexico; NV, Nevada; OH, Ohio; PA, Pennsylvania; SC, South Carolina; US, United States.

Table 2

Park visitation reported across studies; SOPARC review (2006–2014).

First author, publication year	Number of parks	Total days observed	Repeated observations by season	Number of days observed	Weekdays	Weekends	Number of times per day observed	Total number of people observed	Average number of people per park per day	Average number of people per park per observation period
Banda et al. (2014)	6 (May) 6 (October)	4 4	1 1	4 4	2 2	2 2	4 4	97 116	4.0 4.8	1.0 1.2
Child et al. (2014)	8	5	1	5	4	1	4	16,794	419.9	105.0
Chung-Do et al. (2011)	6	5	1	5	3	2	4	6477	215.9	54.0
Cohen et al. (2011)	10	14	2	7	5	2	14	76,632	547.4	39.1
Cohen et al. (2012)	50	7	1	7	5	2	4	213,708	610.6	152.6
Cohen et al. (2013), Ward et al. (2014)	24	12	3	4	2	2	4	35,990	125.0	31.2
Coughenour et al. (2014)	10	2	1	2	1	1	4	1423	71.2	17.8
Floyd et al. (2008a,b) *, Spengler et al. (2011), Suau et al. (2012)	28	3	1	3	1	2	4	9456	112.6	28.1
Floyd et al. (2011) *, Baran et al. (2013)	20	16	1	16	8	8	2	2712	8.5	4.2
Hino et al. (2010)	8	12	1	12	8	4	3	7937	82.7	27.6
Kaczynski et al. (2011), Besenyi et al. (2013)	4	3	1	3	1	2	13	8855	737.9	56.8
McCormack et al. (2014)	4	2	1	2	1	1	2	783	97.9	48.9
McKenzie et al. (2006) *, Cohen et al. (2007)	8	7	1	7	5	2	4	16,244	290.1	72.5
Muftuler et al. (2011)	3	7	1	7	5	2	4	3119	148.5	37.1
Pleson et al. (2014)	7	1 or 2	1	1 in 6 parks, 2 in 1 park	1	0 or 1	1 in 4 parks, 2 in 3 parks	1231	Estimated 153.9	Estimated 107.7
Reed et al. (2008)	25	7	1	7	5	2	4	2544	14.5	3.6

First author, publication year	Number of parks	Total days observed	Repeated observations by season	Number of days observed	Weekdays	Weekends	Number of times per day observed	Total number of people observed	Average number of people per park per day	Average number of people per park per observation period
Reed et al. (2012)	16	4	2	4	2	2	4	4539	35.5	8.9
Reed and Hooker (2012)	45	7	1	7	5	2	4	2852	9.1	2.3
Roemmich and Johnson, (2014)	16	16	4	4	3	1	3	11,811	46.1	15.4
Rung et al. (2011) *; Broyles et al. (2011)	37	2 to 4	1	2 to 4	2 to 4	0	6	Estimated 7231	Estimated 65.1	Estimated 10.9
Shores and West, (2008a,b)	4	7	1	7	5	2	4	2113	75.5	18.9
Shores and West, (2010)	8	7	1	7	5	2	4	6545	116.9	29.2
Temple et al. (2011)	6	4	2	2	1	1	2 on weekdays; 1 on weekends	2844	118.5	Estimated 79.0
Van Dyck et al. (2013)	20	3	1	3	2	1	4	1836	30.6	7.7

A * indicates the article used for the numbers provided in the table. The following calculations were used:

Number of days observed = (Weekdays + Weekends)

Total days observed = (Repeated observations by season * Number of days observed)

Average number of people per park per day = (Total number of people observed) / (Number of parks * Repeated observations by season * Number of days observed)

Average number of people per park per observation period = (Average number of people per park per day / Number of times per day observed).

Table 3

Summary of findings in park target areas; SOPARC review (2006–2014).

First author, publication year	Accessible	Usable	Organized	Equipped	Supervised	Dark	Empty
Banda et al. (2014)	4 parks 100% in both seasons; 1 park 63% in May, 38% in October; 1 park 77% in May, 94% in October	>96% at both time points	<5% at both time points	<5% at both time points	<5% at both time points		>94% at all parks at both time points
Child et al. (2014)	91%	95%	12%	15%	13%		53%
Chung-Do et al. (2011)	99%	98%	3%	0%	1%		
Cohen et al. (2011)							Mean 76%; range 57–89% (summer) and 61–89% (fall)
Cohen et al. (2012)	Mean 86% high poverty, 91% medium poverty, 93% low poverty parks		Mean number 10 high poverty, 17 medium poverty, 18 low poverty parks; range 1–54		Mean 16% high poverty, 26% medium poverty, 31% low poverty parks		Mean 64% high poverty, 61% medium poverty, 57% low poverty parks
Cohen et al. (2013); Ward et al. (2014)	Range 82–99% by site and season	Range 85–100% by site and season	Mean number 16 high poverty and 10 low poverty parks; range 0–2% by site and season	Range 0–4% by site and season	Mean number 18 high poverty and 18 low poverty parks; range 0–4% by site and season	Range 0–9% by site and season	Mean 80%; range 69–90% by site and season
Floyd et al. (2008a,b), Spengler et al. (2011), Suau et al. (2012)			Tampa 16%; Chicago 31%				
McKenzie et al. (2006), Cohen et al. (2007)	89%	93%	2%	2%	3%	1%	57%
Muftuler et al. (2011)			0%				
Pleson et al. (2014)	All parks accessible	6 of 7 parks usable		Each park had at least one area that was equipped	Each park had at least one area that was supervised		
Reed et al. (2008)							No one was observed in two parks for 7 consecutive days
Rung et al. (2011), Broyles et al. (2011)							55%; of 39 sampled parks, 2 had no visitors and were excluded from the analysis

The remaining included articles did not report information on target areas. Empty cells indicate information not reported in the articles.

Table 4

Summary of findings on park users by age, gender, and race/ethnicity; SOPARC review (2006–2014).

First author, publication year	Stratification of results	Age	Gender	Race/ethnicity
Banda et al. (2014)	May October	37% child, 20% teenager, 43% adult 31% child, 29% teenager, 40% adult	59% male 60% male	57% Black, 40% White 93% Black
Child et al. (2014)		52% 0–17 years, 44% 18–59 years, 4% > =60 years	67% male	
Chung-Do et al. (2011)		29% 0–12 years, 71% > =13 years	64% male	
Cohen et al. (2011)			Average number of people in the park per hour: 21 males (range 9–41); 19 females (range 4–35)	
Cohen et al. (2012)		Mean: 33% children, 15% teenager, 48% adult, 4% older adult	Mean 62% male	
Cohen et al. (2013), Ward et al. (2014)		Range by city: 31–49% children, 6–16% teenager, 37–59% adults, 1–5% older adults	Range 50–61% male	50% (range 22–65%) White, 27% (range 3–67%) Black, 13% (range 5–37%) Latino, 10% (range 7–13%) Other
Coughenour et al. (2014)			59% male youth	
Floyd et al. (2008a,b), Spengler et al. (2011), Suau et al. (2012)	FL	Mean 56% 0–12 years; 44% > =13 years	51% males	
	IL	Mean 66% 0–12 years; 34% > =13 years	68% males	
Floyd et al. (2011), Baran et al. (2013)		Youth only: 43% 0–5 years, 41% 6–12 years, 16% 13–18 years	57% male	
Hino et al. (2010)		Age collected by gender only; parks male: 14% children, 18% teenager, 60% adult, 8% older adults; parks female: 15% children, 11% teenager, 68% adult, 7% older adult; squares male: 16% children, 37% teenager, 39% adult, 8% older adult; squares female: 14% children, 18% teenager, 55% adult, 13% older adult	Parks: 63% male; squares: 70% male	
Kaczynski et al. (2011), Besenyi et al. (2013)		22% 2–12 years, 6% 13–20 years, 67% 21–59 years, 5% > =60 years	50% male	65% White, 18% Black, 15% Hispanic, 2% Asian
McCormack et al. (2014)		mean 38% youth (range 23–59%), mean 62% adults (range 41–77%) (range 41–77%) adults	mean 59% male (range 54–65%), mean 40% female (range 35–45%)	
McKenzie et al.(2006), Cohen et al. (2007)		mean 33% children, 19% adolescent, 43% adult, 5% older adult	mean 62% males	80% Latino, 19% Black, 1% White, 1% Other
Muftuler et al. (2011)		10% children, 11% teenager, 68% adult, 12% older adult	49% male	
Pleson et al. (2014)		12% children, 3% teenager, 22% adult, 61% older adult, 2% missing	44% male; 0.3% missing	

First author, publication year	Stratification of results	Age	Gender	Race/ethnicity
Reed et al. (2008)			63% male	69% White, 31% Other
Reed et al. (2012)		45% 0–12 years, 26% 13–20 years, 28% 21–59 years, 2% > =60 years	55% male	55% White, 43% Other
Reed and Hooker (2012)		Youth only: 79% 0–12 years, 21% 13–20 years	58% male youths	56% White youths, 44% Other youths
Roemmich and Johnson, (2014)		40% 0–12 years, 11% 13–18 years, 49% ≥19 years	54% male	
Rung et al., 2011; Broyles et al. (2011)			54% male	
Shores and West, (2008a,b)		29% children, 15% teenager, 52% adults, 5% older adults	53% male	50% White, 38% Black, 11% Hispanic, 1% Other
Shores and West, (2010)	Rural Urban	28% children, 23% teenager, 42% adult, 6% older adult 54% children, 17% teenager, 24% adult, 6% older adult	51% male 52% male	
Van Dyck et al. (2013)	Overall	22% children, 28% teenager, 47% adult, 3% older adult	60% male	67% White, 14% Other, 11% Latino, 8% Black, 0.3% missing
	Belgium	14% children, 46% teenager, 35% adult, 5% older adult	51% male	89% White, 9% Other, 0% Latino, 1% Black, 1% missing
	CA	28% children, 15% teenager, 55% adult, 2% older adult	66% male	52% White, 17% Other, 19% Latino, 12% Black, 0% missing

When means are presented, they are averaged across all observed parks. Numbers may not add to 100% due to rounding. Some studies provided results stratified by a variable (month, season, urbanicity, location) and if so they are listed in column 2. Empty cells indicate information not reported in articles.

Abbreviations: CA, California; FL, Florida; IL, Illinois.

Table 5

Summary of findings on physical activity by park users; SOPARC review (2006–2014).

First author, publication year	Stratification of results	Overall physical activity			Physical activity		
		Sedentary	Walking	Vigorous	By age	By gender	By race/ethnicity
Banda et al. (2014)	May October	62% 28%	28% 18%	10% 54%			
Child et al. (2014)		Mean 50%, range 43–57%	Mean 27%, range 14–31%	Mean 23%, range 13–32%			
Chung-Do et al. (2011)		60%	26%	14%	Age ≤ 12 vs. age > 12: vigorous 21% vs. 12%, moderate 22% vs. 27%, sedentary 57% vs. 62%	Female vs. male: vigorous 12% vs. 15%, moderate 24% vs. 27%, sedentary 64% vs. 58%; for those > = 13 years, females more likely to be sedentary than males; males > = 13 years (13%) and 0–12 years (21%) more likely to engage in vigorous activity than females > = 13 years (8%) and 0–12 years (20%), respectively	
Cohen et al. (2012)		Mean 68%	Mean 17%	Mean 14%		Females more likely to be sedentary (range 34–37%) compared to males (range 19–28%)	
Coughenour et al. (2014)		21%	38%	41%		Males: 17% sedentary, 37% walking, 46% vigorous; females: 26% sedentary, 40% walking, 35% vigorous	
Floyd et al., (2008a,b),	Overall FL	65% 70%	23% 21%	11% 8%	Among children: 56% sedentary, 27% walking, 18%	Males: 66% sedentary, 24% walking, 10% vigorous;	
Spengler et al. (2011),					vigorous; among adults: 77% sedentary, 20% walking, 4% vigorous	females: 73% sedentary, 20% walking, 7% vigorous	
Suau et al. (2012)	IL	51%	28%	22%	Among children: 48% sedentary, 28% walking, 24% vigorous; among adults: 53% sedentary, 28% walking, 19% vigorous	Males: 50% sedentary, 28% walking, 22% vigorous; females: 52% sedentary, 27% walking, 21% vigorous	
Floyd et al. (2011), Baran et al. (2013)		53%	34%	13%	Children 0–5 years were more active than other	Girls had lower levels of physical activity than boys	

First author, publication year	Stratification of results	Overall physical activity			Physical activity		
		Sedentary	Walking	Vigorous	By age	By gender	By race/ethnicity
					youth age groups		
Hino et al. (2010)		More sedentary in squares than parks				Parks: male 26% sedentary, 27% walking, 47% vigorous; female 23% sedentary, 32% walking, 45% vigorous; squares: male 34% sedentary, 28% walking, 38% vigorous; female 36% sedentary, 16% walking, 48% vigorous	
Kaczynski, (2011,2013), Besenyi et al. (2013)		53%	41%	6%	Children (54% MVPA) were most active followed by teenagers (53% MVPA), older adults (51% MVPA), and adults (44% MVPA)	More males (49%) than females (46%) engaged in MVPA	Higher MVPA among Asians (57%) followed by Whites (48%), Blacks (45%), and Hispanics (44%)
McCormack et al. (2014)		Range: 1–16%	Range: 7–59%	Range: dog related activity 5–42%, running 3–4%, cycling 3–28%, playing 2–34%			
McKenzie et al. (2006), Cohen et al. (2007)		66%	19%	16%		Males: sedentary 62%, walking 19%, vigorous 19%; females: 71% sedentary, 18% walking, 10% vigorous	
Muftuler et al. (2011)		Did not record sedentary categories	81%	19%			
Pleson et al. (2014)		14%	37% walking, 8% moderate	37% vigorous, 4% missing	Among older adults: 9% sedentary, 40% walking, 10% moderate, 35% vigorous, 5% missing		
Reed et al. (2008)		15%	51%	34%		Male: 14% sedentary, 44% walking, 43% vigorous; female: 17% sedentary, 63% walking, 20% vigorous	White: 19% sedentary, 45% walking, 37% vigorous; Other 22% sedentary, 54% walking, 24% vigorous
Reed et al., (2012)		21%	38%	41%	0–12 years: 13% sedentary, 36% walking, 51% vigorous; 13–20 years 18% sedentary, 32% walking, 51% vigorous; 21–59 years 38% sedentary, 45%	Female: 26% sedentary, 40% walking, 34% vigorous; male: 17% sedentary, 36% walking, 46% vigorous	White: 21% sedentary, 31% walking, 48% vigorous; Other: 20% sedentary, 48% walking, 32% vigorous

First author, publication year	Stratification of results	Overall physical activity			Physical activity		
		Sedentary	Walking	Vigorous	By age	By gender	By race/ethnicity
					walking, 17% vigorous; > = 60 years 28% sedentary, 58% walking, 14% vigorous		
Reed and Hooker (2012)		18%	36%	46%	Children: 15% sedentary, 39% walking, 46% vigorous; teenager: 27% sedentary, 25% walking, 48% vigorous	Boys more vigorous than girls	
Roemmich and Johnson, (2014)					Males and females > = 19 years had the lowest average intensity compared to other age groups across the 4 seasons	Males generally had higher average intensity than females across 4 age groups and the 4 seasons	
Rung et al. (2011), Broyles et al. (2011)						Mean energy expenditure per male user 2.9 METS, female user 2.5 METS	
Shores and West, (2008a,b), *		42%	20%	41%	Children and teenagers more likely to be vigorous while adults and older adults more likely to be sedentary		Blacks 40% sedentary, 14% walking, 46% vigorous; similar for other races
Shores and West, (2010)	Rural	51%	7%	43%	Youth more active than other age groups (discussion only)	Males observed in more moderate and vigorous physical activity than females (discussion only)	
	Urban	23%	5%	72%			
Temple et al. (2011)	May, June, September 2007	Multiuse park 43%; walk-through park 7%; neighborhood park 37%	Multiuse park 44%; walk-through park 83%; neighborhood park 63%	Multiuse park 13%; walk-through park 19%; neighborhood park 0%			
	January–April 2008	Multiuse park 10%; walk-through park 3%; neighborhood park 0%	Multiuse park 80%; walk-through park 85%; neighborhood park 100%	Multiuse park 10%; walk-through park 12%; neighborhood park 0%			
Van Dyck et al. (2013)	Overall Belgium CA	45% 54% 39%	18% 21% 17%	36%; 0.7% missing 24%; 2% missing 45%; 0% missing			

Abbreviations: METS = metabolic equivalent; MVPA = moderate to vigorous physical activity.

A * indicates the article used for the numbers provided in the table. When means are presented, they are averaged across all observed parks. Numbers may not add to 100% due to rounding. Some studies provided results stratified by a variable (month, season, urbanicity, location) and if so they are listed in column 2. Empty cells indicate information not reported in the articles. The original SOPARC protocol defined intensity as follows: sedentary (lying down, sitting, or standing in place), walking (casual pace), or vigorous activity (more than an ordinary walk).

Table 6

Reliability results reported among included studies; SOPARC review (2006–2014).

First author, publication year	Sample size (Number of raters)	Measurement statistic	Total number of people observed	Age	Gender	Race/ethnicity	Physical activity	Target area characteristics
Banda et al. (2014)	May ~621, October ~642 (2)	Intraclass CC	0.99	> 0.90	> 0.90	> 0.90 for White and Black, 0.81 Latino, 0.57 Other	> 0.90	
	May ~621, October ~642 (2)	Percent agreement						100% accessible; 99% usable; 100% organized; 100% equipped; 100% supervised; 100% empty
Chung-Do et al. (2011)	757 (2)	Kappa					Mean 0.84, range 0.44–0.95	
	757 (2)	Percent agreement						> 97% for accessible, usable, organized, equipped, supervised
Cohen et al. (2011)	147 (2)	Percent agreement	87% among non-empty target areas	82% among non-empty target areas		82% among non-empty target areas	80% among non-empty target areas	
Cohen et al. (2013); Ward et al. (2014)	15% of observations (2)	Percent agreement	87% among non-empty target areas	82% among non-empty target areas		82% among non-empty target areas	80% among non-empty target areas	
Coughenour et al. (2014)	10 (2)	Percent agreement			85–100%		85–100%	
Floyd et al. (2008a,b), *; Spengler et al. (2011); Suau et al. (2012)	342 (2)	Kappa					Range 0.73–0.96	0.99 usable; 0.89 organized
Floyd et al., 2011 (physical activity); Baran et al., 2013 (age, gender)		Kappa		0.81 (0–5 years), 0.81 (6–12 years), 0.69 (13–18 years)	0.85 (girls), 0.78 (boys); 0.88 (women), 0.83 (men)		Range 0.46–0.71	
Hino et al. (2010)	128 (2)	Percent agreement		90%			90%	
McCormack et al. (2014)	72 (5) 72 (5)	Kappa Percent agreement		0.71 86.4%	0.89 94.7%			

First author, publication year	Sample size (Number of raters)	Measurement statistic	Total number of people observed	Age	Gender	Race/ethnicity	Physical activity	Target area characteristics
McKenzie et al. (2006) *, Cohen et al. (2007)	236 (2)	Percent agreement			84% female, 85% male			98% accessible; 94% usable; 97% organized; 99% equipped; 97% supervised
	236 (2)	CC	0.99					
Muftuler et al. (2011)	10 (2)	Percent agreement		93% child, 95% teenager, 95% adult, 91% senior	97% female, 99% male		97% walking, 72% vigorous	
Rung et al. (2011), Broyles et al., 2011	310 (2)	CC	0.99				Range 0.84–1.00 among nonempty target areas	

Abbreviations: CC, correlation coefficient.

A * indicates the article used for the numbers provided in the table. The remaining included articles did not report reliability for data collection. Empty cells indicate information not reported in the articles.